

The
FOOD VALUE
of the
BANANA





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THE FOOD VALUE OF THE BANANA

A Compilation from Recognized Authorities

FOURTH EDITION

Research Department
United Fruit Company
Boston, Massachusetts

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The Food Value of the Banana

Balanced Diet and Food Economics

During the past twenty years there has been a remarkable increase in the knowledge of nutrition. The World War compelled every one to think seriously of food production as well and was a large factor in establishing real education in food values and food economics.

Today, the public knows that there is no one food complete in itself, and that daily requirements of the human body must be met by the purchase of several varieties, many of which in part are duplicates. This knowledge has made the people better judges of what to buy and also keener critics of the claims of rival food products. Although indications are that we have not been wholly successful in solving the questions of diet raised by changed living conditions, decreasing physical exercise and new and different types of food,¹ nevertheless the importance of a rational, i.e., a well-balanced diet to the individual and hence to public health is now well recognized.

Since finances as well as health play a part in this selection, an equally significant problem today is to purchase at minimum cost all the articles that are necessary to the daily food supply.

On the average, half or more of the family income is spent for food. In the household of a wage-earner food is the largest single item in the family budget.²

As an editorial in the "Journal of the American Medical Association"³ puts it:

The leading economic question now before the people is the purchase of staple foods at moderate cost.

To answer this question one must know what the main food constituents are and the relative amounts which the body, in health, requires.

¹ Cf. *Annual Report*, United States Public Health Service, December, 1925.

² McCollum, E. V., and Simmonds, Nina: *The Newer Knowledge of Nutrition* (3d ed., New York, Macmillan, 1925), p. 52.

³ October 24, 1925.

General Facts of Nutrition

Food is required by the body for the production of energy and heat; for the restoration of tissue lost through wear and tear; for growth; and for protection against disease. To fulfil these purposes, the daily ration must contain the following nutrients:

Carbohydrates, in the form of starch and sugars. These are supplied for the most part by cereals, vegetables, and a few fruits.

Proteins. These nitrogenous compounds are derived principally from meats, eggs, milk, cereals, and such vegetables as peas and beans.

Fats of animal and vegetable origin.

Mineral Salts, principally of calcium, phosphorus, and iron. The amounts required are relatively small but are of great importance.

Vitamins. The principal sources of these substances are dairy products, fats, vegetables, and fruits.

Water in appreciable amounts is also essential in the daily diet.

Carbohydrates and fats furnish energy and heat. Proteins are essential to the construction of body tissue, for the repair of worn-out cells, and are also sources of energy. Mineral salts are important constituents of the body and are necessary to the maintenance of health. Vitamins, of which there are at least five, designated by the letters A, B, C, D and E, are essential for the utilization of foods, for maintenance and growth, and afford protection against scurvy, rickets and other "insufficiency" diseases.

The fuel or energy value of food is calculated from its power to produce heat when burned. The unit of measurement in dietetics is the Calorie, the amount of heat required to raise the temperature of a litre of water 1 degree Centigrade, or a pound of water (one pint) 4 degrees Fahrenheit. In spite of recent discoveries that the value of some of the essential food elements, i. e., the vitamins and mineral salts, cannot be expressed

in energy or heat units, "the fact is that the appreciation of the Calorie idea in nutrition has not gone out but, on the contrary, has become a permanent part of everyday science."¹

The importance of a plentiful source of Calories at low cost is stressed when we consider the daily needs of individuals of varied age and occupation:

DAILY REQUIREMENT ²

<i>Children</i>	<i>Calories</i>
Boys 6-7 years.....	1400-1700
Girls 6-7 years.....	1300-1600
Boys 15-16 years.....	2700-3300
Girls 15-16 years.....	2150-2450

<i>Adults</i>	<i>Calories per Pound of Body Weight</i>	<i>Man Weighing 150 Pounds</i>
Sedentary occupation.....	14-16	2000-2400
Light physical exercise.....	16-18	2400-2700
Moderate exercise.....	18-20	2700-3000
Hard labor (muscular).....	20-23	3000-3500

In general terms, therefore, it may be stated that a healthy man weighing 150 pounds requires daily in a temperate climate and in the performance of ordinary work, a food intake equivalent approximately to 3,000 Calories. It is now generally recommended that 10 to 15 per cent of the Calorie requirement be proteins, and that the rest be provided by, approximately, twice as much fat and five times as much carbohydrate.

The desirability of reducing the protein content of the diet was first suggested by Professor Chittenden, of Yale University, since the members of his large group of men under close observation were well-nourished and in perfect health on a daily protein ration of two ounces or even less. These results were later confirmed by the war-time experiments in food economics of Benedict and others in 1917. Doctors Chace and Rose, as a result of their tests, stated:³

This means that a mature man of average size need not consume more than 40 grams of protein a day and under stress of circumstances can get along on less.

¹ Editorial, *Journal of the American Medical Association*, October 24, 1925.

² Rose, M. S.: *Laboratory Handbook of Dietetics* (New York, Macmillan, 1925).

³ Chace, Arthur F., and Rose, Anton R.: "Dietetic Treatment of Nephritis," *Journal of the American Medical Association*, Vol. 69 (1917), p. 440.

These experiments, which suggest the desirability of reducing proteins in the interest of health and economy, emphasize also the relative importance of selected carbohydrate foods. It is evident that in any balanced diet the energy-giving foods, such as carbohydrates, must form the larger part.

The Banana an Important Staple Food

A staple food is one that is abundant, always obtainable, of moderate cost and high food value, as well as palatable and easily digested. The banana meets these requirements.

With its near relative, the plantain, it constitutes an important source of carbohydrate food for enormous numbers of people in many parts of the tropics.¹

The creation from tropical jungles in widely separated areas, of enormous plantations, protected by constant and extensive sanitation; the construction of railroads and docks and the development of adequate steamship facilities of specialized types, have made the banana a staple food also available throughout the year for people of the temperate zones.

J. Russell Smith, Professor of Economic Geography at Columbia University, in his valuable book, "The World's Food Resources,"² says:

The possibilities of the banana as a food resource for the temperate zone have only begun to be developed.

The importance of the banana has been recognized long since by Sir James Crichton-Browne, the famous British physician and Fellow of Royal Society, who wrote in a letter to W. Fawcett, of London, under date of December, 1912:³

Extended experience of the banana has deepened my conviction of its food value. It is a great boon to the masses of our people and while retaining its place on the dessert table of the rich, has found its way into the hands of the poor. Its portability, palatability, digestibility are immense advantages.

Many leading authorities have agreed with these statements. A few of the more recent opinions are here quoted:

¹ It is the fruit of a certain species of *Musa*, a tree which grows abundantly in the lowlands of the tropics that have an ample rainfall. The plant attains a height ranging from eighteen to thirty feet in about fourteen months and produces only one bunch or "stem" of bananas. When the fruit is harvested the tree is cut down.

² (New York, Holt, 1919), p. 170. ³ Quoted in Fawcett, *The Banana* (London, 1921), p. 108.

In his article "The Banana: A Food of Exceptional Value," Professor Samuel C. Prescott, of the Massachusetts Institute of Technology, states:¹

The fact that bananas may be obtained in abundance throughout the year, that they may be shipped for long distances under suitable conditions, without being impaired in any way, that they may be used as a fruit or as a vegetable, cooked or raw, * * * * shows clearly that in this remarkable fruit we have an adjunct to our dietary which should not be over-looked.

Professor Walter H. Eddy, of Teachers' College, Columbia University, in his article "The Food Value of the Banana," appearing in "Modern Priscilla," March, 1926, says:

Few of the dietary contributions of nature offer us more values with less danger to health than this common fruit.

Dr. G. Carroll Smith, author of "What to Eat and Why," states:²

Until comparatively recent times considered as a luxury, the banana is now abundant, easily obtained and available to people of the temperate zones at moderate cost. In palatability and digestibility, qualities which are closely related, the banana has demonstrated its usefulness not only for adults but for children, and for the healthy individual as well as the convalescent. The cleanliness of the banana, protected in its unbroken skin from all contamination, is absolute.

The banana is, therefore, to be considered not a luxury, but a valuable addition to the standard food supply. Its greater utilization is an important factor in the solution of the economic problem of supplying the increasing world population with a staple food, obtainable at all seasons and at low cost.

The Banana Compared with Other Foods

Laboratory experiments and actual food tests by dietitians have established the following facts:

The banana is one of the most important carbohydrate heat or energy-producing foods and is a good source of mineral salts and vitamins; it contains some protein and fat, but in small quantities. Measured in terms of food value, the banana costs on an average throughout the year less than any of the other fresh fruits and most of the common vegetables.

¹ Scientific Monthly, Vol. 6 (1918), p. 74.

² Foreword to the Food Value of the Banana, 2d ed. (Skinner, Sherman and Esselen, compilers), (Boston, Leonard, 1926).

Many analyses of the banana have been made by eminent investigators. Atwater and Bryant in Bulletin 28 of the United States Department of Agriculture,¹ present the following interesting comparison of the edible portion of the banana with that of other fruits:

	<i>Water</i>	<i>Protein</i>	<i>Fat</i>	<i>Carbo- hydrate</i>	<i>Ash</i>	<i>Calories per lb.</i>
Apples.....	84.6	.4	.5	14.2	.3	290
Bananas.....	75.3	1.3	.6	22.0	.8	460
Blackberries.....	86.3	1.3	1.0	10.9	.5	270
Blueberries.....	81.9	.6	.6	16.6	.3	345
Cherries.....	80.9	1.0	.8	16.7	.6	365
Grapes.....	77.4	1.3	1.6	19.2	.5	450
Muskmelons.....	89.5	.6		9.3	.6	185
Oranges.....	86.9	.8	.2	11.6	.5	240
Peaches.....	89.4	.7	.1	9.4	.4	190
Plums.....	78.4	1.0		20.1	.5	395
Strawberries.....	90.4	1.0	.6	7.4	.6	180

A comparison of the food values of the banana and meats should be made only with the realization that they belong in different classes.

The banana is mainly a carbohydrate or energy-producing food, while meats are essentially protein foods, adapted to the building of tissue.

Professor Samuel C. Prescott, in his paper previously quoted, states:

The banana contains all the classes of food materials required for the animal body. Although the amounts of protein and fat are too low to constitute a perfectly balanced ration, the combination of banana with milk, in proper proportion, or its utilization as a vegetable to supplement a diet containing a small amount of meat, will produce a ration which is ample to take care of the body needs. Meats are essentially protein foods, and as such are more adapted to the development of tissue than to the quick production of heat, while the banana, on the other hand, is less a tissue-forming substance, but is incomparably more effective in supplying the heat-giving materials. In a crude way we might say that the proteins are the foods which make good the losses due to wear and tear in the machinery of the body, while the carbohydrates are the foods which keep the machinery in motion and do work.

It is undesirable and uneconomical to have too much protein in the diet. Only the nitrogen needed for the repair and building of tissue is utilized, the surplus being excreted.

¹ (Rev. ed., Washington, Government Printing Office, 1906), pp. 68-71.

COMPARATIVE FOOD-UNIT COSTS AT RETAIL IN 1927¹

	<i>*Cost per Pound as Purchased (in Cents)</i>	<i>Calories per Pound As Purchased</i>	<i>Cost of 100 Calories As Purchased (in Cents)</i>	<i>Calories Purchased for Five Cents</i>
Flour.....	5.5	1610	0.3	1465
Rolled Oats.....	9.0	1811	0.5	1005
Beans, navy.....	9.3	1565	0.6	840
Rice.....	10.7	1591	0.7	743
Bread.....	9.3	1182	0.8	637
Potatoes.....	3.8	302	1.3	398
Butter.....	55.6	3491	1.6	313
Cheese.....	37.6	1990	1.9	265
Milk, fresh.....	7.0	314	2.2	224
Rib Roast.....	31.3	1262	2.5	202
BANANAS.....	8.0	290	2.8	181
Pork Chops.....	36.8	1230	3.0	167
Onions.....	6.4	199	3.2	156
Corn, canned.....	17.8	455	3.9	128
Cabbage.....	5.3	121	4.4	114
Lamb, leg of.....	38.9	876	4.4	113
Sirloin Steak.....	42.6	960	4.4	113
Eggs, strictly fresh...	30.0	594	5.1	99
Ham, sliced.....	55.0	1073	5.1	98
Peas, canned.....	13.4	252	5.3	94
Round Steak.....	37.1	649	5.7	88
Tomatoes, canned....	9.6	169	6.0	83

*Certain items are shown in the United States Monthly Labor Review as purchased on other than the unit pound basis. To make the above table uniform, Skinner, Sherman and Esselen, Inc., have converted these items to the pound basis as follows:

Milk, fresh.....	14.1 cents per qt.	1 qt. = 2 lbs.
Bananas.....	34.0 cents per doz.	1 doz. = 4.27 lbs. (av.)
Eggs, strictly fresh...	45.2 cents per doz.	1 doz. = 1.5 lbs. (av.)
Corn, canned.....	15.7 cents per No. 2 Can	No. 2 Can = 20 oz. (1.25 lbs.)
Peas, canned.....	16.8 cents per No. 2 Can	No. 2 Can = 20 oz. (1.25 lbs.)
Tomatoes, canned...	12.0 cents per No. 2 Can	No. 2 Can = 20 oz. (1.25 lbs.)

These figures show that measured by food value and price the banana is surpassed only by such concentrated foods as dry cereals, and a few others such as beans, potatoes, milk products, and rib roast.

A fact that should not be lost sight of is that before being eaten most foods must be cooked — with, usually, a considerable loss of their Calorie value. As actually eaten, therefore, the banana, in comparison with such foods, ranks relatively higher in Calories than is indicated by the foregoing table.

Furthermore, retail prices of many foods are subject to considerable seasonal variation, while the market price of bananas is fairly stable throughout the year.

¹Compiled by the Bureau of Labor Statistics of the United States Department of Labor ("Monthly Labor Review," February, 1928, p. 168). The Calorie figures in the second column are taken from "The Chemistry of Food and Nutrition," by Professor H. C. Sherman, Columbia University. From these two sources the figures in the third and fourth columns have been prepared by Skinner, Sherman & Esselen, Inc., Consulting Chemists, of Boston.

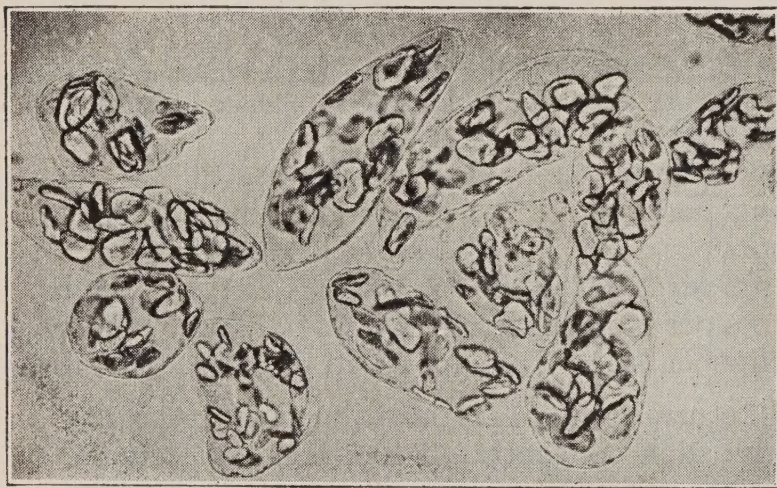
Ripeness and Digestibility of the Banana

Any mistaken impression that bananas are difficult to digest is due to eating them before they are ripe. In this respect they do not differ from apples, pears, melons, or any other fruit which, if eaten when they are green, may cause digestive disturbance. When ripe, or if cooked when partially ripe, the banana is easily digested and of great value in the diet of both young and old.

The banana is one of the few fruits that attain maximum flavor and food value when harvested green and allowed to ripen off the tree. As shipped from the tropics and discharged from the steamship, the fruit is green and hard, and its carbohydrate content is almost entirely starch.

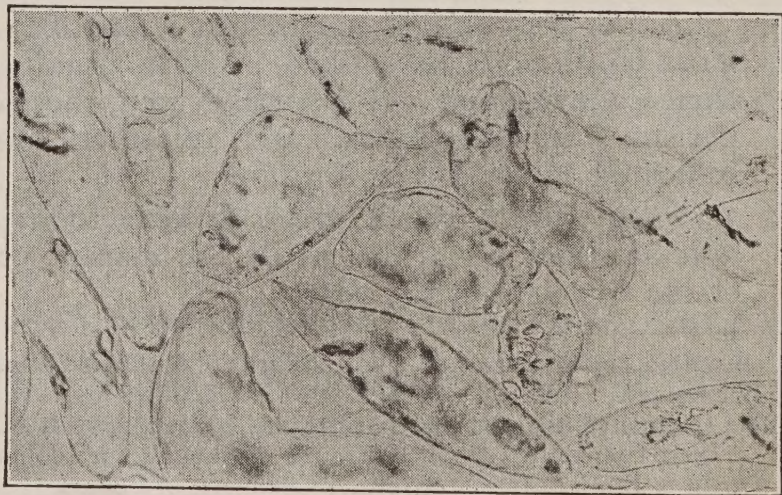
During the process of ripening, the starch in the banana gradually becomes converted into easily digested sugars.

The following microphotographs by Professor Francis E. Lloyd, MacDonald Professor of Botany at McGill University, show this process.



GREEN BANANA—Showing all the cells with their complement of starch grains entire. Cooking renders the green banana nutritious and digestible.

FULLY RIPE BANANA—Showing most cells entirely free from starch. The pulp is now of fine, mellow texture and one of the most digestible of foods.



The peel first becomes yellow except for a green tip. At this stage only a portion of the starch has changed to sugar and bananas should not be eaten raw, but may be cooked in many tempting ways and used as a vegetable or a dessert.

In the next stage, called the "yellow-ripe," the pulp begins to soften and the peel is readily removed. The fruit now has a delicious flavor, and can be easily digested. It is recognized by most people that further ripening improves the banana and that it is at its best when the peel has become flecked or spotted with brown. Then practically all the starch is converted into sugars, the flavor developed to its highest delicacy, and the fruit most digestible.¹

CHANGES IN APPEARANCE AND COMPOSITION OF THE BANANA AS IT RIPENS

<i>Days off Boat</i>	<i>Ratio of Pulp Weight to Total Weight</i>	<i>Carbohydrates</i>		<i>Appearance of Peel and Flavor of pulp</i>	
		<i>Starch</i>	<i>Sugars</i>		
2	60.1%	20.25%	2.31%	Peel green; separates from pulp with difficulty. Pulp hard.	In Jobber's Ripening Room
4	62.5%	11.85%	10.02%	Peel green but beginning to turn yellow. Pulp softening but still unripe.	
6	67.8%	6.83%	14.62%	Peel yellow with green tip. Pulp only partially ripe and should not be eaten raw.	In Dealer's Store
8	69.5%	4.67%	16.65%	Peel all yellow. Pulp edible but not best flavor.	
10	70.2%	3.92%	17.21%	Peel all yellow—beginning to fleck. Pulp good flavor.	In the Home
12	72.1%	0.72%	18.78%	Peel flecked with brown. Pulp now fully ripe and at its best for flavor and nutrition.	

These results represent average practice as determined in the Research Department Laboratories of the United Fruit Company at Boston. Temperatures used in the ripening rooms may considerably accelerate or retard the ripening process. After the fruit leaves the jobber, weather conditions determine its further progress, and ripening will be faster in summer and slower in winter. Best results are obtained with temperatures between 60 and 70, and fairly high humidity. The fruit should never be subjected to temperatures as low as those found in household refrigerators.

¹ See illustrations on back cover of this pamphlet.

Bananas, until fully ripe, should be kept at a moderate room temperature — **not in the ice chest**, a mistake commonly made — as cold prevents proper ripening and the development of the fine natural flavor.

Food experiments by dietitians have shown that the carbohydrates of the ripe banana are in simpler form and consequently are more readily digested and assimilated than those of cereals or potatoes, and that digestibility is directly proportional to the ripeness of the fruit.

Dr. Arnold Lorand, of Carlsbad, states:¹

There is probably no more nourishing fruit, or one whose cultivation would be more valuable for mankind, than the banana. As far as its digestibility is concerned, I have personally observed that when eating a perfectly ripe banana, it will almost melt in the mouth, when simply turned around several times, without any actual mastication.

Careful studies on the digestibility of the banana have been made by Drs. Victor C. Myers and Anton R. Rose.² In their many practical tests they noted no discomfort where the fruit was ripe when eaten. The carbohydrates were well absorbed from the intestine and no ill effects were observed even after the consumption of large quantities of the ripe fruit for several days.

The Banana a Naturally Sealed Package

Unlike many fruits, the banana reaches the consumer in a germ-proof package, sealed by Nature. The thick, enveloping peel, largely fibrous in its structure, and with compact outer surface, effectively protects the edible portion, i. e., the pulp, from bacteria, molds, or other forms of contamination. Furthermore, the pulp is peculiarly immune from insect pests; a worm-eaten banana is unknown.

Composition of the Ripe Banana

The preceding table shows that the edible portion or pulp forms about 72 per cent and the peel about 28 per cent of the ripe fruit.

¹ *Health and Longevity through Rational Diet* (Philadelphia, Davis, 1913), p. 299.

² "The Nutritional Value of the Banana," *Journal of the American Medical Association*, Vol. 68 (1917), pp. 1022-1024.

A summary of numerous analyses of the edible portions of the ripe banana by eminent authorities presents a picture somewhat as follows:

The pulp contains about 72 to 76 per cent of water; 15 to 20 per cent of total sugars, of which sucrose (cane sugar) may be as little as 2 per cent or as much as 14 per cent, and the remainder, "invert sugar," i. e., a mixture of equal parts of dextrose and levulose; from 7 per cent of starch in the yellow ripe banana to practically no starch in the fully ripe fruit, flecked with brown; 1.3 per cent protein of nitrogenous matter; about 0.3 to 0.6 per cent of fat; about 0.3 to 1.0 per cent of crude fibre or cellulose; and about 0.7 to 1.2 per cent of ash.

In addition, the pulp contains small amounts, usually less than 1 per cent, of various substances, the most important of which are fruit acids and esters, which largely determine the flavor and aroma of the fruit.

The Banana and Mineral Salts

In any consideration of foods, the importance of the inorganic constituents, commonly known as mineral salts, should not be overlooked. While only relatively small quantities are necessary, they are essential to the body needs. Phosphorus is widely distributed in the body, and is as essential to the living cells as are the proteins, while calcium and iron are necessary for the development of bone and blood.

The banana contains appreciable quantities of these valuable mineral salts, consisting principally of the phosphates, sulphates, and chlorides of potassium, sodium, magnesium, and calcium, as well as significant amounts of iron.

The Bureau of Public Health Education of the New York City Department of Health, in Bulletin No. 7 (1917), states:

The onion, like most green vegetables, is of value in the diet chiefly for the mineral salts which it contains. It is these and not its protein that make it a valuable addition to bread and meat. Bread and cereals and meat are described by the chemist as having an excess of acid-forming over base-forming mineral matters. Green fruits and vegetables are of the opposite character, having an excess of base-forming minerals. A proper balance of these two classes of minerals in the diet is essential to health. There is danger at the present time, when vegetables are unusually costly, that the health of the community may suffer from a deficiency of base-forming minerals in the diet. It is important, therefore, to call attention to the fact that apples, bananas, and oranges, which have not greatly advanced in price, may be used as substitutes for vegetables. They contain the same mineral matter in varying proportions. Apples, bananas and oranges all surpass onions in their excess of base-forming minerals.

The table below shows the amount of the three important inorganic elements found in a few of our most common fruits:

	<i>Grams per 100</i>	<i>Grams Edible</i>	<i>Substance</i>
	<i>Phosphorus</i>	<i>Calcium</i>	<i>Iron</i>
BANANAS.....	0.031	0.009	0.0006
Apples.....	0.012	0.007	0.0003
Oranges.....	0.021	0.045	0.0002

Bananas then not only supply at a low cost the principal nutrient mineral elements, but in such proportions that the fruit when eaten has an alkaline effect, and thus provides a corrective for the acid tendency of many of our common foodstuffs.

It is of interest that both the banana and the potato yield an alkaline ash and are therefore antagonistic to the development of acidosis.¹

In his recent article on Acidosis, Dr. W. D. Sansum states:²

In preventing or curing an acidosis, oranges together with apples, muskmelons, bananas, and potatoes are very efficient. Too much cannot be said about the value of fruits in a diet, for in addition to their alkalinizing effect, they have a high food value and contain an abundance of the minerals and vitamins.

The Banana a Good Source of Vitamins

Since 1906 dietitians have learned that a selection of foodstuffs supplying nutrients in proper kind and amount may still fail to nourish unless there be present definite though small amounts of substances now known as "vitamins." The daily requirements of these substances and the amounts in foods are so small that as yet they have not been measured.

Vitamins have not yet been isolated, but modern science has found a way to express the adequacy of a food as a source of these factors and has taught us that there are at least five which must be in the daily diet or illness of one sort or another follows. At present these factors are designated by letters and are recognized as vitamins A, B, C, D and E, each with a different protective function. The importance of this protection is emphasized by McCollum and Simmonds:³

We are taking too little of the protective foods, milk, the leafy vegetables and fresh fruits, and a movement toward stimulating the consumption of these classes of foods would go far toward effecting that improvement in our national health standards for which the many agencies concerned with the public health are seeking.

¹ Myers, Victor C., and Rose, Anton R., *op. cit.*, p. 1023.

² "Acidosis — How Foods may be Effectively Used in its Prevention and Cure, with Menus," *Food Facts*, Vol. 3, No. 1 (May, 1927), p. 12.

³ *Op. cit.*, p. 539.

Vitamins, designated by Funk in 1910 as "a group of indispensable, nutritive complexes," are necessary for growth and maintenance of health. They are unequally distributed in foodstuffs and their principal sources are dairy products, fats, vegetables, and fruits. Vitamin A insures protection against eye-disease; vitamin B, against beri-beri; vitamin C, against scurvy; vitamin D is the anti-rachitic factor; and vitamin E, the anti-sterility factor. Others have been discovered, named alphabetically and their properties and functions are being studied.

The vitamin value of the banana had been only partially investigated in the years prior to 1925. During that year quantitative studies were carried out by Professor Walter H. Eddy, in the Physiological Chemistry Laboratory of Teachers' College, Columbia University, and established the following important facts:¹

Although it contains a much higher proportion of water, the banana, in vitamin A, in spite of its low fat content, is about one twentieth the value of pure butter and equal to vegetables fairly rich in this vitamin, for example, green peas.

Of vitamin B, important in many respects other than prevention of disease, the banana has been found to be a good source, and in this respect is, weight for weight, the equivalent of tomato juice and nearly equal to a good quality of milk.

In vitamin C, the anti-scorbutic vitamin, the banana has been found to be nearly twice as rich as previously reported, and to compare well with oranges and tomatoes.

In October, 1926, Professor Walter H. Eddy reported further:²

From the various tests now available it seems safe to class the banana as an excellent source of vitamins A and C; a good source of vitamin B; deficient in vitamin D and not lacking in vitamin E. Its potency in C, the availability and the relative cheapness of the fruit, make it a competitor with tomato juice and orange juice for use in infant feeding on vitamin basis alone. Its use will not, however, eliminate the necessity for cod liver oil or sunlight to avoid incidence of rickets.

¹ Cf. Eddy, W. H.: "The Vitamin Content of Foodstuffs," *American Journal of Public Health* (February, 1926).

² "The Place of the Banana in the Diet," *American Journal of Public Health*, Vol. 17 (January, 1927), pp. 31-32.

Emphasizing the relative importance of vitamin A, Professor H. C. Sherman of Columbia University states:¹

Thus there is abundant evidence that a shortage of vitamin A in the food results, sooner or later, in a widespread weakening of the tissues and functions of the body. It seems likely that vitamin A plays the double role of a tissue constituent and also of a "regulatory" substance concerned with the maintenance of normal conditions and the control of nutritional processes. . . .

Vitamin A thus becomes a very important factor in food values, and it may be said in conclusion that this vitamin should always be held clearly and prominently in mind in any comprehensive consideration of food values or of nutritive requirements.

Therapeutic Value

Not only has the banana an important place in the dietary in normal health, but it has been found of value in the treatment of certain diseases. In his paper, "The Place of the Banana in the Diet," before the American Public Health Association at Buffalo, October 13, 1926, Professor Eddy reports:

Through the courtesy of Dr. Joseph A. Johnston, of the Department of Pediatrics, Harvard Medical School, Children's Hospital, Boston, we submit herewith X-ray and other data pertaining to a case of infantile scurvy treated and cured by a diet consisting solely of bananas and milk. The baby was eight months old and weighed twelve pounds. A banana-milk diet was made by whipping into 570 c.c. of milk 200 g. of ripe, raw banana. The baby was fed 120 c.c. of this mixture every four hours. No other food or anti-scorbutic was necessary. The child tolerated the mixture without any signs of digestive disturbance, gained in weight and recovered from scurvy. In this case the banana not only provided the anti-scorbutic but also the necessary carbohydrate to modify the milk suitably.

The results confirm the conclusion stated by Sugiura and Benedict² in 1919, viz.:

Our experiments suggest that a combination of bananas and milk, in proper proportion, constitutes a complete food.

In a subsequent article, entitled, "Place of the Banana in the Diet of Children," Dr. Johnston states as his "Conclusions":³

1. Ripe banana can be fed with safety to very young infants.
2. It constitutes a most valuable addition to the diet of any child, but particularly of that group of children whose ability to gain in weight is the most important factor influencing their recovery from protracted illness, but whose appetite must be tempted by more than the usual staples.
3. The banana is of therapeutic value in scurvy and celiac disease.

¹ "The Vitamins," *Journal of Chemical Education*, Vol. 4, No. 1 (January, 1927), pp. 68-70.

² Sugiura, K., and Benedict, S. R.: "The Nutritive Value of the Banana," *Journal of Biological Chemistry*, Vol. 36 (1918), pp. 171-189; Vol. 40 (1919), pp. 449-468. (Statement quoted will be found on p. 468.)

³ The *Journal of the American Dietetic Association*, September, 1927.

Following is the summary and discussion of a paper by Dr. L. von Meysenbug, Instructor in Pediatrics, Tulane University, reporting a case of scurvy cured by a banana diet.

SUMMARY: A 19 months old baby, weaned at 4 months, and put on a diet of pasteurized and boiled milk with no anti-scorbutic showed marked pallor, severe anemia, bleeding gums, a rapid heart with systolic apical murmur and X-ray changes typical of scurvy. The diagnosis was clean cut and scorbutic.

One tablespoon of banana, increased daily, was added to the diet, which was otherwise not changed and which contained no other anti-scorbutic.

The subsequent course showed a disappearance of the scurvy.

DISCUSSION: Dr. Joseph Yampolsky, Atlanta, Georgia—The case of scurvy cured with a banana diet is another testimonial in favor of this fruit as a food for infants. Not only is the banana a valuable food with curative qualities, but it is easily obtained and its cheapness places it within the reach of the very poorest.

In the treatment of cases where the protein intake of the dietary must be restricted, inclusion of bananas in the ration of patients suffering from nephritis (inflammation of the kidney), for example, has been found to be of distinct advantage. Drs. Chace and Rose, in their discussion of this disease, state:¹

In interstitial nephritis the most characteristic phenomenon is the lowered permeability of the kidney for the nitrogenous constituents of the urine. The more protein there is in the diet, the more these substances accumulate in the blood, overtaxing the kidney and causing intoxication of the whole organism. Hence, the first dietary consideration in these cases is limitation of the nitrogen intake.

Drs. Myers and Rose have found the banana a means of supplying calories for nephritic patients:²

The banana would appear to be a particularly valuable food to employ in the dietetic treatment of nephritic patients with nitrogen retention. Very satisfactory results have been obtained in the rather mild cases of nephritis here reported. So long as the patients exhibit no distaste for the fruit, there would seem to be no reason why bananas should not be employed in considerable quantity.

Dr. Sidney V. Haas, of New York, has used bananas extensively in the treatment of celiac disease (chronic intestinal indigestion), one of the most troublesome disturbances of nutrition of late infancy and early childhood.³ This disease is characterized by inability to utilize properly the carbohydrates and

¹ Chace, Arthur F., and Rose, Anton R., *op. cit.*, p. 440.

² *Op. cit.*, p. 1024.

³ Haas, Sidney V.: "The Value of the Banana in the Treatment of Celiac Disease," *American Journal of Diseases of Children*, Vol. 28 (1924), pp. 421-437.

fats. In his dietetic treatment of this disease, Dr. Haas has rigorously avoided carbohydrates, except those of the extremely ripe banana, and small quantities which occur in certain milk products. With these exceptions it has been impossible, in severe cases, to give any carbohydrate without producing unfavorable symptoms; the ripe banana, however, is not only well tolerated, but rapidly changes the entire clinical picture of disease to one of well-being.

An excellent confirmation of Haas's work is given in a paper by Dr. Henry Eugene Irish, of Chicago, entitled, "A Case of Celiac Disease with 'Banana Treatment'":¹

This case of celiac disease is reported because the weight was nearly doubled after a year's treatment as an outpatient on a high protein diet, with low fat and carbohydrate largely in the form of raw bananas.

In this case reported the banana pulp was obtained from ripe fruit as evidenced by golden yellow color with black spots on the skin. They were freed from any dark spots on the pulp and were passed through a potato ricer and fed with a spoon. The amount fed at first was a half-ounce daily, and, being tolerated well, was rapidly increased to three whole bananas in a day. . . . No adequate explanation has been advanced to show why banana sucrose is tolerated when cane or beet sucrose must be prohibited.

This patient, a girl $4\frac{1}{2}$ years old, weighing $19\frac{1}{2}$ pounds, was placed on this dietetic treatment October 1, 1924. The gain in weight for six months was seven pounds, 37 per cent of the presentation deficiency — and for twelve months $11\frac{1}{2}$ pounds. At the end of the year her weight was 31 pounds. The gain in height was four inches and she was slightly overweight for her height.

Since in celiac disease children will not tolerate any of the usual forms of carbohydrate or fat, it has been necessary heretofore to provide nourishment mainly in the form of protein as the only means of keeping them alive. Dr. Haas's work showed that banana carbohydrate was tolerated by these cases when other forms of carbohydrate were not. Dr. Irish has found the same result. He has combined a high protein and low fat diet with banana and found the child to tolerate it satisfactorily. Dr. Irish states in conclusion:

In the author's case the bananas were taken eagerly, were a means of breaking the monotony of diet and did not interfere with the restoration of normal stools or the excellent progress made by the child.

¹ *Archives of Pediatrics*, Vol. 43 (1926), p. 533.

Bananas in the Children's Dietary

As food for children, ripe bananas are especially good, because they are nutritious and easily assimilated. The flavor is so delicious that a child will eat them with enjoyment in place of sweets. Ripe bananas as well as the cooked unripe fruit are being used more and more in the dietary of young children.

Among the dietitians who have given careful study to bananas as a food for children are Drs. Pease and Rose of the New York Post-Graduate Medical School and Hospital. The following quotation¹ summarizes in part the conclusions of their clinical experience:

The banana is a useful fruit that can with profit enter liberally into the child's dietary, provided it is fully ripe, or well cooked. If eaten baked in the yellow stage of ripeness, or if eaten raw when fully ripe, the banana makes a delightful and highly nutritious article of food. Its composition does not warrant the use of bananas as the main component of the child's dietary, but it can compete well with other fruits, and is decidedly to be preferred to candies. . . . The banana ought not to be eaten raw until after the brown spots begin to appear. It is at this stage a full golden yellow, and at its most attractive appearance. A completely browned skin is not in itself a sign of over-ripeness and such fruit should be judged by the texture of the pulp. The brown color of the peel, however, should not be confused with the darkening due to bruises. . . . The banana properly handled and allowed to ripen to its most beautiful color and texture is a wholesome food, uncontaminated by dirt and pathogenic germs even if purchased from the push cart in our congested streets.

In an address before the Orleans Parish Medical Society in New Orleans, May 9, 1927, on "The Banana as a Food for Infants and Children," Dr. L. von Meysenbug, Instructor in Pediatrics, Tulane University, stated:²

During the past year I have fed banana to ninety infants ranging in ages from four months to two years. All of these were well infants, though many had not gained satisfactorily and several suffered from marked constipation. . . .

My records show that of these ninety babies to whom banana was given, only two could not tolerate it because of its laxative effect. . . .

It is in the constipated babies that some interesting results were obtained. Some were completely cured, others greatly benefited. . . .

That the banana may cause rapid gain in weight when other food is not sufficient is shown by a number of the cases. . . .

¹ "The Banana as a Food for Children," *American Journal of Diseases of Children*, Vol. 14 (November, 1917), p. 390.

² Vol. 80, No. 3, September, 1927, *New Orleans Medical and Surgical Journal*, pp. 180-184.

A communication on this subject from Dr. P. G. Shipley, Associate Professor of Pediatrics of the Johns Hopkins University and Associate Attending Pediatricist of the Johns Hopkins Hospital, states:

We use the raw banana extensively in the dietary of children and prescribe it in appropriate quantities in the treatment of celiac disease or chronic intestinal indigestion. It is a very valuable article of food.

Ruth F. Wadsworth, M.D., in her article, "And Everything Nice," published in "Collier's" for May 26, 1928, states:

Concerning fruit there is a common prejudice that much fruit will cause diarrhea; that bananas are, in some occult manner, dangerous; that cooked fruit is safer than raw fruit; that core, seeds, skin, coating and fibre of fruits should not be given to children.

As a matter of fact, it takes enormous quantities of ripe fruit to give a child true diarrhea, or, in fact, to cause any infrequency of bowel movement. In midsummer the skins of fruit sometimes contain bacteria which cause diarrhea. And any fruit which has been sprayed while on the tree may contain, on its skin, traces of chemicals which cause cramps. A safe preventive method is to wash fruit thoroughly if the skin is to be eaten, and to peel it in midsummer.

Bananas, as we have said before, are an excellent, nutritious and safe food.

Raw fruit is infinitely more beneficial to children than cooked fruit. Generally children will not eat, from choice, core or seeds or rind, but if they do it won't hurt them. The banana need not be scraped nor the inner coating of the orange punctiliously removed.

Clarence W. Lieb, A.M., M.D., in an article entitled "Our Changing Ideas about Diet," in "Woman's Home Companion" of June, 1928, writes:

The banana, formerly condemned as indigestible, is now recognized as wholesome, easily digested, high in vitamins, and is even included in the diet of infants. It must be eaten thoroughly ripe or cooked.

Bananas and Milk

In "Hygeia" of May, 1927, Dr. Hilbert F. Day, of the Harvard Medical School Faculty, and President of the Cambridge Anti-Tuberculosis Association, has given the record of a 1926 summer class of underweight school children, treated for eight weeks by sunlight, fresh air, exercise, with special attention to diet in which bananas and milk were an important item. Reporting the excellent results, Dr. Day, under the caption, "Bananas and Milk are Good Team," says:¹

This indicates an ideally balanced and highly nutritional ration.

¹ Sunshine Camp in Cambridge, *Hygeia*, Vol. 5 (May, 1927), pp. 248-251.

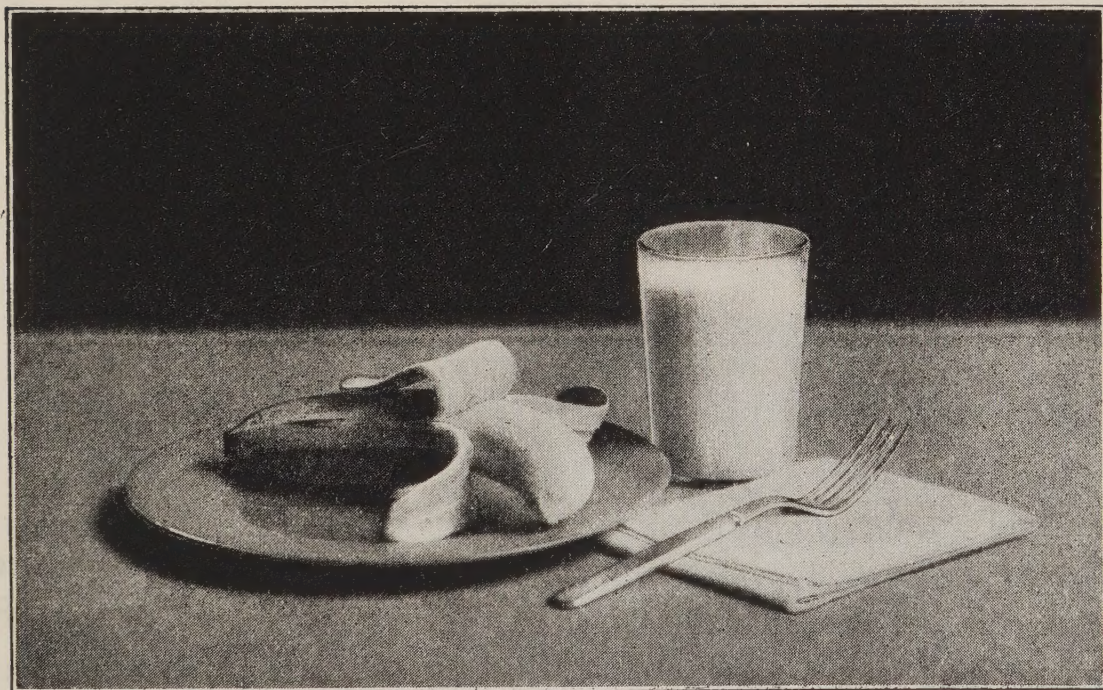
Dr. Day has also published a record of the 1927 summer class maintained by this Association. The class consisted of thirty girls from seven to twelve years old, selected by school physicians and nurses from the Cambridge public schools.

At the opening of the camp the composite weight chart of the class showed the average weight to be 60.2 pounds. Normal weight would have been 69.4, hence, the average underweight was 9.2 pounds or 15.5 per cent. At the end of the eight weeks' session a similar composite chart showed an average gain of 6.79 pounds, or 11.4 per cent. In other words, the class as a whole had made up 74 per cent of its weight deficiency.

Dr. Day in his report states:¹

The two constant daily items of diet were bread and butter, and milk and bananas. Whole wheat bread, because of its vitamins A and B and its mineral content, practically twice that of white flour bread, was served instead of white bread, with butter at every meal.

McCollum's doctrine, "We are taking too few of the protective foods, milk, leafy vegetables, and fresh fruits," now an accepted dietetic principle, was definitely kept in mind.



"A combination of bananas and milk, in proper proportion, constitutes a complete food."

A glass of milk at each meal and at midmorning lunch, provided each member of the class with a quart a day, supplying not only the calcium but largely the protein requirement and making meat almost unnecessary.

¹*Journal of the National Education Association*, June, 1928, pp. 169-172.

Milk, although the most important and satisfactory article of food for growing children and the main reliance of a summer camp like ours, is far from a complete food. It must be supplemented by other foods and its deficiencies corrected. Since it contains eighty-eight per cent water (the legal standard in Massachusetts) it is too bulky to be an exclusive item of diet. As a balanced food it is markedly deficient in carbohydrate, having only one and one-half times as much of the heat and energy-producing carbohydrate as of the tissue-building protein. Furthermore, pasteurization of milk entirely destroys the important vitamin "C." . . .

In Boston, as in practically all metropolitan districts, the milk used is pasteurized, and rightly. Safety is a first consideration. This fact, however, necessitates the supply of vitamins from other sources, generally, as for our children, from fresh fruits. While our camp menu contained oranges twice a week, our main fresh fruit reliance was ripe bananas.

The following table shows how the addition of banana restores to pasteurized milk its vitamin values, with increase of vitamin "C."

	<i>Vitamins</i>		
	<i>A</i>	<i>B</i>	<i>C</i>
Milk (whole)	****	***	*
" (pasteurized)	****	**	—
" (pasteurized plus bananas)	*****	***	**

In Calorie value the high carbohydrate content of a banana supplies in large measure the needed deficiency, making, with a glass of milk, a well-balanced ration. This is shown clearly in the following schedule from Locke's "Food Values."

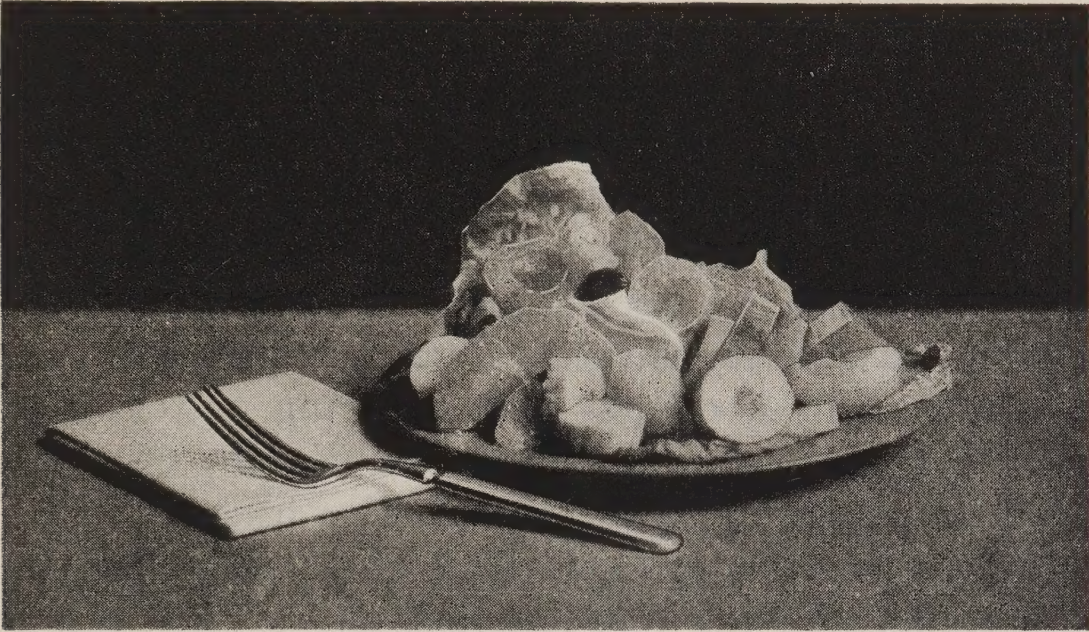
	<i>Carbohydrate</i>	<i>Calorie Values</i>		
		<i>Fat</i>	<i>Protein</i>	<i>Calories</i>
Milk (1 glass)	45.1	81.8	29.8	157
Banana (average size)	113.7	7.3	6.4	127
Total	158.8	89.1	36.2	284

It is our experience that in a well-studied diet for underweight children, bananas and milk should have an important place.

Many Ways of Using Bananas

Bananas have a place in the menu of virtually every meal and can be prepared and served in many tempting ways. For breakfast the fresh, ripe fruit is eaten sliced in milk or cream, with or without cereals. As an entree, banana fritters are especially pleasing. To fruit cocktails and the fruit salads, ripe bananas give not only flavor but substantial food value; while for desserts, served in many attractive ways—for example, in gelatine, custard, ice cream, or in shortcake or pie—they are delicious and wholesome.

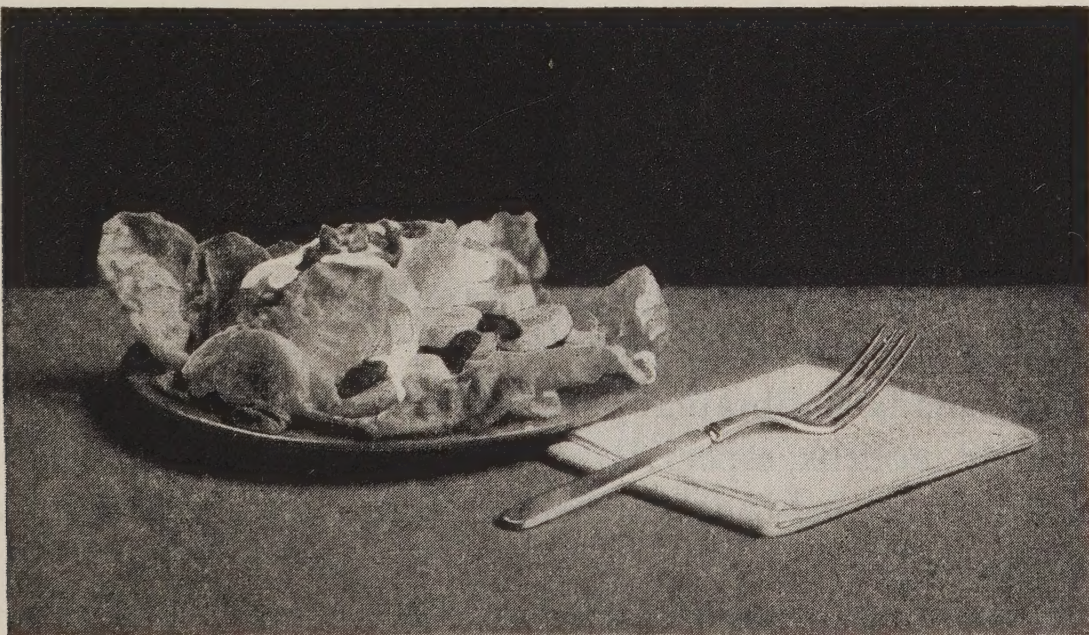
Bananas sliced with other fruits, especially with apples, oranges, or grapefruit, make a very desirable and appetizing dish. As a fresh fruit, eaten alone or in combination with other fruits and for salads and desserts, the sugary, ripe banana should always be used.



"Bananas sliced with other fruits, especially with apples, oranges, or grapefruit."

A salad of juicy fruits, in which bananas are used to furnish the carbohydrates and nuts the protein content, constitutes a dish of well-balanced nutrients.

The banana also fills an important place in the laborer's dinner pail, the children's lunch box, the school and factory cafeteria, and the picnic hamper.



Bananas, nuts and whipped cream—"A dish of well-balanced nutrients."

Summary

The banana is a delicious fruit and one of the most important energy-producing foods. When used with milk, its carbohydrate content makes an ideally balanced ration; when combined with other fresh fruits and the leafy vegetables, it supplies the needed Calories.

Its small quantity of protein and fat enables the dietitian, as is often necessary, to increase Calorie values without appreciably adding to the protein content.

As a protective food the banana is an excellent source of vitamins A and C and a good source of vitamin B; it also has an appreciable quantity of the essential mineral salts.

It is a nutritious, natural food requiring no, or only the simplest, preparation. It may be served in many ways and its flavor blends agreeably with those of other fruits.

Measured in terms of food value, the banana costs on an average throughout the year less than any of the other fresh fruits and most of the common vegetables.

Tests by eminent dietitians have shown that when fully ripe, or if cooked when partially ripe, the banana is easily digestible and possesses great food value in the dietary of both young and old.

In the treatment of certain diseases—chronic intestinal indigestion in children (celiac disease), scurvy, and inflammation of the kidney (nephritis)—the banana has proved of great value.

With proper care it may be shipped to distant points without deterioration. It reaches the consumer in a germ-proof package.

Since cold prevents proper ripening and the development of the fine, natural flavor, bananas should not be kept in the ice box unless they are fully ripe.

The banana is obtainable in abundance at all seasons. In the winter months, especially, it provides an inexpensive food, particularly needed in the diet, often too low in fresh fruits and green vegetables.

All these facts show clearly that this remarkable fruit is a valuable addition to our staple food supply.

THE BANANA AS IT RIPENS



1-PARTIALLY RIPE BANANA yellow with green tip -
In this state bananas should be cooked and eaten as a vegetable.



2-YELLOW RIPE BANANA without trace of green -
The fruit now has a delicious flavor and is readily digested.



3-FULLY RIPE BANANA flecked with brown - Now at its best for flavor
and nutrition and of all foods one of the most easily digested.